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(54) **Process for removing fine impurities from a fibrous material suspension**

(57) The process relates in particular to the removal of fine impurities from fibrous material suspensions of recycled paper. It is suited for the removal of sticky contamination. In a multi-stage wet screening process (3), whereby the rejects are introduced to the sorting devices (7, 7') in the subsequent stages, the accepted stock fraction (9") is, according to the invention, treated in preferably the last stage (6) in a flotation step (4). In this manner a large portion of the fine floatable impurities are removed by means of a relatively small flotation cell (12) in an especially economical manner

Fig. 1

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Description

[0001] The invention relates to a process for removing fine impurities from a fibrous material suspension according to the introductory clause of Claim 1.

[0002] As is well known, fibrous material suspensions, in particular those that are recovered from recycled paper and are used for paper manufacturing, contain a more or less large amount of undesired attendant materials, so-called interfering materials, that must be removed in the preparation unit. Interfering materials are usually removed in various stages, as they almost never can be removed in a single process stage. Wet screening processes have proven particularly effective for the removal of fine impurities. In this process, the suspension is directed to a screening device and separated into at least two fractions, an accepted stock fraction, that is the material that has passed through the screen, and a reject fraction, the material that has been rejected because of size. Generally, in paper making jargon, such wet screen processes are called sorting. Subjecting the material removed, that is the reject fraction, to one or more additional subsequent screening stages is also known. One speaks in such cases of a multi-stage sorting. Multi-stage sorting can be conducted at various points in paper fiber preparation, whereby it is generally true that, the later this occurs in the process, the finer the screen pore sizes can be selected. Examples of the multi-stage wet screening process of the type referenced here are shown in the technical article "Sortierung von Altpapierstoff ur Herstellung von graphischen Papieren[1]" by R. Rienekker from the Wochenblatt für Papierfabrikation No. 23/24, 1997, pages 1149 to 1159.

[0003] Although a number of different systems for cleaning paper fiber suspensions are known and used, all of the undesired impurities are not always removed from the suspension. In particular, very fine sticky contamination, which, even in small amounts, often causes great difficulties in the production of paper, can only be removed at great expense—if at all.

[0004] The invention relates to the task of creating a process, whereby, it is possible to remove a good amount of fine impurities while keeping the required process technology expenses to an acceptable level.

[0005] The task is completely solved by the aspects set forth in Claim 1.

[0006] In the multi-stage wet screening process referenced here, the rejects from the previous sorting stage are introduced to the intake of the subsequent sorting stage. Thereby, one can assume that the quality of the accepted stock is different, depending on whether it comes from the first, second or subsequent stages. And to be sure, the contaminant level of the accepted stock generally increases from stage to stage. In all efforts to achieve as good a selectivity as possible for the sorting devices, one must assume that in such technical processes a certain—albeit as small as possible—portion of the interfering material to be sorted out will remain in the accepted stock. Due to the aforementioned increase in the contaminant level from stage to stage, the accepted stock in the last stage will contain the comparably highest amount of interfering material. This holds particularly true for interfering materials that are very fine or that do not have a stable form and can easily remain in the accepted stock during the wet screening process. In certain instances, the contaminant level in the accepted stock from the sorting device that is not the last stage can be the highest. That will be discussed in more detail.

[0007] Through the process according to the invention, a particularly economical means has been found to quantitatively remove such fine interfering materials. This takes advantage of the fact that the amount of accepted stock decreases from stage to stage while the amount of interfering material increases. Even the aforementioned fine interfering material, which cannot always be removed completely by means of the wet screening process can be particularly effectively removed by means of a flotation process, provided that the interfering material is hydrophobic. This includes particularly, the aforementioned sticky contamination. In such instances a flotation step is used that functions selectively, that is, the hydrophilic fibers remain in the accepted stock and only the interfering material is concentrated in the flotation foam. Such selective flotation processes are well known, and do not have to be discussed here. Appropriately, the suspension is prepared prior to the actual flotation, so that as large a portion of the interfering material contained therein is floatable. Such preparation can be done mechanically or chemically. For example, it is possible and appropriate for the surface activity of the material to be floated off to be increased using chemical means, to increase its hydrophobicity.

[0008] The invention and its advantages are described using exhibits. Wherein:

Fig. 1 a basic process scheme to execute the process;

Figs. 2 –7 variants of the process

[0009] In Fig. 1 one sees the process divided into individual stages: dispersion 1, pretreatment 2, wet screening 3, flotation step 4, and other processing 5. It is known that during dispersion, the paper fiber is mixed with water and reduced

[1] Translator's Note: Sorting of Recycled Paper Material for the Manufacture of Graphic Papers in the Weekly Journal for Paper Fabrication.

to the extent that a pumpable and if possible a fiber free suspension results. Usually, the pre-treatment (2) is also performed early, i.e., using hydrocyclones or screen filters. At this point the removal of printing inks, or de-inking, can also take place. At this point in the process, the dispersal can also be well advanced. The material can be well fiberized and thus optimally prepared for wet screening. Dispersion and pre-treatment (2) are usually not separate, as is shown here for simplification purposes, but take place alternately and in partial stages.

[0010] After both of these process stages are performed, the suspension S arrives in the multi-stage screening process 3. In the example shown, this contains three sorting devices 7, 7', 7". The sorting devices usually contain at least one screen, which separates the incoming suspension S into the accepted stock fraction 9 or 9' or 9" and the reject fraction 8 or 8' or 8". The sorting devices are adjusted so that the subsequent stage accepts the reject fraction of the previous stage. The wet screening process 3 referenced here is three staged. The accepted stock fraction 9" is treated in the last stage 6 in a flotation step using a flotation cell 12. The fine interfering material is removed as completely as possible in the reject fraction 11 and the cleaned fiber suspension arrives for further processing 5 as the accepted stock fraction 10 together with remaining accepted stock fraction 9, 9'.

[0011] In many instances the example of a three stage wet screening process selected here may be optimal in the technical and economic sense. But there are also other conceivable instances where perhaps two stages will suffice, as is shown in Fig. 2, or more than three stages are selected. This obviously depends on the conditions and requirements.

[0012] It is also easily feasible to combine the penultimate stage with a flotation stage. This can improve the process for those instances where too much interfering material is contained in the accepted stock in the penultimate stage. Such a variation is shown in Fig. 3. In particular instances, when the last stage 6 is performed so that only a relatively small amount of interfering material remains in the accepted stock (i.e., by means of very fine screen pores), just the flotation of the accepted stock fraction from the penultimate stage alone could suffice.

[0013] One could also direct the accepted stock fraction 9' from the second stage, that is, the sorting device 7' together with the accepted stock fraction 9" from the last stage 6 to the flotation cell and set it correspondingly larger.

[0014] In the embodiment according to Fig. 4, a particular action is taken to improve the accepted stock in the second stage. Two sorting devices 7' are linked consecutively with respect to the accepted stock and the combined rejects 8' are

directed to the sorting device 7" and to the last stage 6. In this manner the quality of the accepted stock fraction 9' from the second stage can be adjusted to the accepted stock fraction 9 from the first stage.

[0015] Fig. 5 shows a recognized process variation in a multi-stage wet screening process. Therein, the reject 8" from the last stage 6 is introduced to a further sorting device 13. The accepted stock fraction 15 from this sorting device is fed back and arrives together with the reject fraction 8 from the first stage to the sorting device 7" in the last stage 6. The reject fraction 14 from the sorting device 13 is discharged from the system. This so-called cascade system results in additional expense for just a two stage wet screening process. In special instances, however, this can offer advantages.

[0016] A particular advantage can also be offered if the process is varied so that the accepted stock fraction 9" from the last two stages 6' and 6 is cleaned in a flotation step 4. Fig. 6 shows such an instance. Similar considerations as those set forth in connection with Fig. 3 could play a role, namely that the accepted stock fraction could contain too high a level of impurities, even in the penultimate sorting device. Furthermore, the penultimate sorting stage can be run with a higher throughput as this is still cleaned as accepted stock. Thereby the final sorting device 7" is smaller or it can be run more effectively.

[0017] Fig. 7 shows a particular embodiment of the pre-treatment 2. According thereto, a large part of the printing ink particles can be removed from the fibrous material suspension—as has already been discussed—by means of flotation. Then the process according to the invention in many instances results in an improvement in the quality of the material. It has been shown that the flotation step 4 is particularly effective if it can focus on interfering material that is not printing ink, but is floatable. This primarily relates to the adhesive and hot melt interfering material, i.e., sticky contamination that—as opposed to printing inks—can often be removed more easily with fewer chemicals. This special focus on sticky contamination is naturally easily possible if no printing inks have to be removed, i.e., raw materials for packing papers.

[0018] It is known that the effectiveness of the sorting process is greatly affected by the density of the material and the size of the screen pores. It is also usual to sort the fibrous material suspension in a preparation unit with material densities of 2-4% and screen pores of approximately 2 mm and at another point with slits of a width of approximately 0.2 mm and material densities of below 1%. The process according to the invention can be used in both examples referenced, whereby the results will naturally vary. Material densities of 2-3% are also possible when sorting with slits of approximately 0.2 mm wide.

This leads to a relatively large mass flow rate with good sorting quality and therefore to an optimum operation in the technical and economical sense.

Patent Claims

1. Process to remove fine contaminates from a fibrous material suspension (S), in particular a fibrous material suspension containing recycled paper, whereby the fibrous material is cleaned after suspending in water, the so-called dispersion (1) and a possible pre-treatment (2) in a multi-stage wet screening process (3), whereby at least two, preferably three screening devices (7, 7', 7") are connected to each other so that the reject fraction (8, 8') removed from the screen is introduced to the attached screening devices (7', 7") until the last stage (6) of the wet screening process is reached, whereby the reject fraction (8") is removed,
wherein at least one accepted stock fraction (9', 9") from at least one of the stages following the first stage is cleaned by at least one flotation step, whose reject fraction (11) contains a major portion of the impurities and whose accepted stock fraction (1) contains the overwhelming portion of the fibers.

2. The process in accordance with claim 1,
wherein, the accepted stock fraction (9', 9") that exhibits the highest portion of floatable interfering material, is cleaned in a flotation step.

3. The process in accordance with claim 1 or 2,
wherein the accepted stock fraction (9', 9") of the last stage (6) is cleaned in a flotation step.

4. The process in accordance with claims 1, 2 or 3,
wherein the accepted stock fraction (9") of the last two stages (6', 6") is directed to the last flotation step (4).

5. The process in accordance with claims 1, 2, 3 or 4,
wherein the accepted stock fraction (9', 9") that is not cleaned in the flotation step (4) is combined and led directly to the further processing (5).

6. The process in accordance with claim 5,

wherein the accepted stock fraction (10) of the flotation step (4) is led to the remaining accepted stock fraction.

7. The process in accordance with the aforementioned claims
wherein a pre-treatment stage (2) is performed in which printing ink particles are also removed.

8. The process in accordance with the aforementioned claims,
wherein the flotation step (4) is performed without chemicals that are specialized for the removal of printing inks.

9. The process in accordance with the aforementioned claims,
wherein the flotation step (4) is conducted primarily without flotation chemicals.

10. The process in accordance with the aforementioned claims,
wherein closed pressure sorters are used as screening devices (7, 7', 7").

11. The process in accordance with claim 10,
wherein the pressure sorters are equipped with screens whose open screen pores contain slits having a width between 0.08 and 0.5 mm.

12. The process in accordance with claim 10,
wherein, the pressure sorters are equipped with screens whose screen pores are holes having a diameter between 0.8 and 3 mm.

13. The process in accordance with claims 10, 11 or 12,
wherein the dry content of the fibrous material suspension (S) in the first stage of the wet screening process (3) is set at a value between 0.6 and 2.5%.

14. The process in accordance with claims 10, 11 or 12,
wherein the dry content of the fibrous material suspension (S) in the first stage of the wet screening process (3) is set at a value between 2 and 4%.

15. The process in accordance with the aforementioned claims,
wherein the flotation step (4) is performed in a selectively functioning flotation cell (12).

16. The process in accordance with the aforementioned claims, **wherein** the suspension to be cleaned (S) contains sticky contamination.

17. The process in accordance with the aforementioned claims, **wherein** the suspension undergoes a chemical treatment prior to or during the flotation step, whereby the surface activity of the interfering material, in particular the sticky contamination, is increased.

18. The process in accordance with the aforementioned claims, **wherein** the fibers are dispersed prior to the flotation step (4).

19. The process in accordance with the aforementioned claims, **wherein** the fibers are dispersed prior to the wet screening process (3).

20. The process in accordance with claims 18 or 19, **wherein** during dispersion a specific energy of at least 20 kWh/to is transferred to the fibers.